

- Verify

However, because "Calculate the template" is not required in this IVI-API; and the system is initialized before the verification process started, the process is:

- Capture
- Verify

The capture() functions are provided in SPI, which can be accessed directly by applications. Both the image in question and the folder of previously stored images are in the hard drive. The applications then pass (String image, long imageID) to the verify() function.

## N:N Matching

The following methods are used to perform the Identification function:

```
int identify(String image );
Long [] getIdentifyID();
String [] getIdentifyName();
Long getIdentifyWeight().
```

Both the image in question and the folder of previously stored images are in the hard drive. The applications then pass (String image) to the identify() function.

## Parameters

The set of parameters forms an array;

```
Void setParameter( int I, long x); // a[I] = x
Long getParameter(int I); // retune a[I]
```

## CLAIMS

What is claimed is:

- 1 A computer implemented process for content-based images search or retrieval with these steps: specifying sample image(s) or/and segment(s) or/and directory and/or directories; specifying training parameters; training by one click; specifying the directory or directories to be searched; specifying search parameters; searching by one click.
- 2 A computer implemented process of claim 1, wherein the order of steps is altered to cover all possible combinations.

3 A computer implemented process for image classification with these steps: specifying sample image(s) or/and segment(s) or/and directory and/or directories; specifying training parameters; training by one click; specifying the directory or directories to be searched; specifying search parameters; searching by one click. Repeat the above process for each class. When all classes are covered, classify the images by one click.

4 A computer implemented process of claim 3, wherein the order of steps is altered to cover all possible combinations.

5 A computer implemented process of claim 1 (search), wherein the steps are saved in the batch code and executed by a batch command. The batch code can be entered into the system in several ways, including:

- Click a save button to save the current setting, including key, search directory, and parameters into a batch code.
- Click a file button to recall one of many batch codes saved earlier.
- Cut and paste or simply type in a batch code by keyboard.
- Obtain the code from a file.

6 A computer implemented process of claim 3 (classification), wherein the steps are saved in the batch code and executed by batch command. The batch code can be entered into the system in several ways, including:

- Click a save button to save the current setting, including key, search directory, and parameters into a batch code.
- Click a file button to recall one of many batch codes saved earlier.
- Cut and paste or simply type in a batch code by keyboard.
- Obtain the code from a file.

7 A computer implemented process of claim 1 and 3 (search and classification), further comprising the step of retraining. This allows the system to be trained by more than one image, or segment of an image, or a directory contains images.

8 A computer implemented process of claim 1 and 3 (search and classification), further comprising the step of simply mapping a part of or all of the parameters to one or two integers represented by Scrollbar(s), thus allowing the simplification of setting parameters.

9 A computer implemented process of claim 1 (search), further comprising output results being listed both in the system and in a new exiting process such as Microsoft Internet Explorer. The output web page has a list of names and weights:

- The weight of an image is related to the characteristics users are looking for (the weight).
- Click the name of each image and an image will pop up on the screen.

10 A computer implemented process of claim 3(classification), further comprising output results being listed both in the system and in a new exiting process such as Microsoft Internet Explorer. The output web page has a list of names and weights:

- An image link for each image in the search directory;
- The classification weights of this image in each search; and
- The classification of this image as a link.

11 A computer implemented process of claim 1 and 3 (search and classification), wherein the steps of setting parameters comprises the "Area of Interest", which specifies an image

segment, which is specified by 4 numbers: the coordinates of the upper-left corner and the bottom-right corner and obtained in two clicks.

- 12 A computer implemented process of claim 1 and 3 (search and classification), wherein the steps of setting parameters comprises the “internal representation”, which specifies the dimensions of a pixel array used for computation, which may or not be the actual image pixel array.
- 13 A computer implemented process of claim 1 and 3 (search and classification), wherein the steps of setting parameters comprises the “Symmetry”, which represents similarity under certain types of changes, such as intensity, translation symmetry, Scaling, Rotation, combined rotation and scaling, or combination thereof.
- 14 A computer implemented process of claim 1 and 3 (search and classification), wherein the steps of setting parameters comprises the “Sensitivity”, which deals with the sample segment size, high sensitivity is for small segment(s) and low sensitivity is for large segment(s).
- 15 A computer implemented process of claim 1 and 3 (search and classification), wherein the steps of setting parameters comprises the “Blurring”, which measure the distortion due to data compression, translation, rotation, scaling, intensity change, and image format conversion, or combination thereof.
- 16 A computer implemented process of claim 1 and 3 (search and classification), wherein the steps of setting parameters comprises the “Shape Cut”, which eliminates many images that have different shapes as the sample segment.
- 17 A computer implemented process of claim 1 and 3 (search and classification), wherein the steps of setting parameters comprise the “image types”, which specifies ABM or APN algorithm.
- 18 A computer implemented process of claim 1 and 3 (search and classification), wherein the parameter is provide in a file, which specify more complicated setting than the graphical user interface. For example, just search through images listed in a file.
- 19 A computer implemented process of claim 1 and 3 (search and classification), wherein the neural layer deploys the ABM or/and APN algorithm.
- 20 The ABM algorithm, including ABM learning algorithm and ABM recognition algorithm.
- 21 The APN algorithm, including APN learning algorithm and APN recognition algorithm.
- 22 A component of the ABM or APN algorithm, “Symmetry”, which is implemented by physically applying the sample image to all possible positions and train the software with all of these transformed image(s) or segment(s).
- 23 A component of the ABM or APN algorithm, “Sensitivity” or whatever the terminology used, which deals a particular way of limiting the relevant neural connections in a particular computation. When ABM net,  $x$ , is trained, there will be certain connections. All possible connections together form a connection space, the connection  $H$ . Deploying a distance in this connection space is an important step in the ABM or APN algorithm (See the description of Sensitivity). The present invention covers all method, combination of limiting a connection set in the connection space, especially with a distance as a parameter.
- 24 A component of the ABM or APN algorithm, “Blurring” or whatever the terminology used, which measures the distortion due to data compression, translation, rotation, scaling, intensity change, and image format conversion. All possible images together form a space, the image space. This method expands an image in the search directory from a single point to a set defined by a distance in the image space (See the description of Blurring). The present

invention covers all method, combination of creating an image set in the image space, especially with a distance as a parameter, for the purpose of expanding the key(s).

25 A component of the ABM or APN algorithm, the “Shape Cut” or whatever the terminology used, is to eliminate many images using the concept of image space (See the description of “Shape Cut”). The present invention covers all method, combination of creating an image set in the image space, especially with a distance as a parameter, for the purpose of limiting the number of images to pass through.

26 A component of the ABM or APN learning algorithm, where the connection space is used to generate connection, rather than a process of repetitions of modifying weights directly and observing the performances. Deploying the connection space for establishing connection is a very important part of the present invention. The present invention covers all method of creating the synaptic connections directly in the connection space, especially with a distance as a parameter.

27 A component of the APN learning algorithm, which converts binary neural net to multi-valued neural net by deploying a mapping for each connection. The present invention covers all type of mapping.

28 A computer implemented process for content-based images verification, identification, retrieval, and classification with software components, which use IVI-API as an application-programming interface.

## **Appendix A Accompanying Application Part**

Sample Invention Application Software: Attrasoft ImageFinder 4.9

- CD
- User’s Guide

Sample Invention Component Software: Attrasoft TransApplet 5.1

- CD
- User’s Guide

Inventor’s Resume